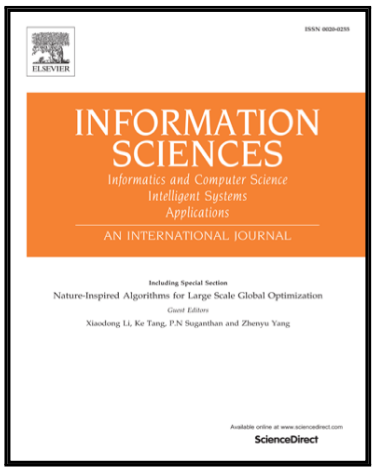

A New Exact Solution Algorithm for a Novel Generalized Redundancy Allocation Problem

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A New Exact Solution Algorithm for a Novel Generalized Redundancy Allocation Problem

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Abstract -- The traditional redundancy allocation problem (RAP) aims to determine a system structure that strikes an appropriate balance between series and parallel components and that maximizes reliability by using redundant components in parallel, thus satisfying resource consumption constraints. The RAP is a well-known NP-hard problem and has been an active area of research for the past four decades. By extending the series–parallel structure to a more general network structure, this paper proposes a novel RAP called the generalized RAP (GRAP). To reduce the computational burden in solving this intractable GRAP, a new algorithm, called the hybrid swarm optimization (HSO), is proposed. The HSO combines concepts from simplified swarm optimization (SSO), particle swarm optimization (PSO), simulated annealing, and network reliability methods. The paper presents designed experiments and computational studies that demonstrate the potential of using the proposed HSO for the GRAP instead of using the genetic algorithm, PSO, or SSO.

Keywords — Reliability; Redundancy allocation problem (RAP); Soft computing; Swarm intelligence

1. Introduction

Recently, reliability in various everyday systems, such as oil and gas production, computing and communications, power transmission and distribution, and transportation, has been widely researched [1,2,6,8,16,22,23,25]. Studies have shown that numerous systems in engineering, industrial, and scientific applications would benefit from improved reliability in the initial stages of their design phase [5,7,10,17,20,24,26,32-34].

Reliability is the probability of a live connection between the source node and the sink node. There are two major methods for improving the reliability of systems: increasing component reliability and